California Environmental Protection Agency

Air Resources Board

QUANTIFICATION OF VENT EMISSIONS FROM PORTABLE FUEL CONTAINERS PRIOR TO FUELING
(May 2005)

Stationary Source Testing Branch
Monitoring and Laboratory Division

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Introduction

The term “vent emission”, also known as “burp emission” are terms used to describe the mass amount of hydrocarbons released from a portable fuel container (PFC) just prior to fueling gasoline powered equipment. As containers are stored, sealed with gasoline and subjected to an ambient temperature increase, gasoline volatizes into vapor and causes the container to expand under slight pressure. Nearly all PFC manufacturers recommend to first vent the container prior to dispensing fuel in order to avoid forced fuel flow.

Staff acknowledges that thin walled containers expand under some ambient conditions and has determined that the pressure increases are minimal. Since the vented emissions are a result of normal, routine use, staff has conducted experiments to quantify the emissions that result.

The first experiments were conducted using pump gas from a local service station. The test data showed that PFC’s loose as much as 4 grams per burp. The Reddy Equation was used to calculate the emissions using headspace and fuel temperature. Staff encountered discrepancies possibly due to the fact that pump fuel had an unknown RVP. In response, staff conducted testing on 24 PFC’s using RFG II Certification Fuel and a Sealed Housing for Evaporative Determination (SHED) to control fuel RVP and temperature. Staff also used a control container, a sealed 5-gallon PFC outfitted with a temperature probe placed in the fuel to ensure the fuel was at the desired temperature as opposed to only measuring air temperature.

Test Protocol

1. Fill each container to 50% capacity with CERT fuel and install spout.
2. Containers must pass a leak test (Cycle 1).
3. For each cycle, containers must acclimate at 65^{o}F for at least one hour with spouts removed prior to starting.
4. Weigh each container once spout is installed. There are 3 weigh-ins for each Cycle:

    a. Prior to starting a Cycle
    b. Immediately prior to burping
    c. Immediately after burping

5. Each burp shall be instantaneous, performed by the same operator.

6. Using a 65^{o}F starting temperature, complete the following cycles in order to examine the effects of temperature vs. pressure and emissions.

   Cycle 1: 65^{o}F to 110^{o}F. Submerge in water tank (leak test)
   Cycle 2: 65^{o}F to 85^{o}F (~2 psi change), burp and weigh
   Cycle 3: 65^{o}F to 95^{o}F (~3 psi change), burp and weigh
   Cycle 4: 65^{o}F to 105^{o}F (~4 psi change), burp and weigh

7. Repeat steps 4-6 to complete remaining cycles.
8. For each weigh-in, calculate the evaporative losses.

Test Results: Quantification of Vent Emissions

The attached Figure 1 summarizes the results of testing. Each episode for each container was calculated by subtracting the final mass measurement from the initial. After calculating the mass emission losses, the results were then averaged to arrive at an overall composite average. Since the average portable fuel container in California has been determined to be 2.34 gallons in size, staff elected to report the results from the 2 to 2.5 gallon containers using the tiered temperature results. Staff believes the measurements taken from the tiered temperature measurements are the most accurate as some emissions were lost from evaporation during the single temperature profile warm up period. A listing of the tiered temperature averages are summarized below in Table 1.

Table 1

Summary of Vent Emission Averages	
Container Size	Vent Emission (grams)
1-gallon	2.90
2 - 2.5-gallon	3.36
5-gallon	7.55

Conclusion

As shown in Figure 1 and Attachment 1, venting a portable fuel container while under a pressurized state produces evaporative emissions that are released to ambient air. The amount of emissions is easily measured using an electronic balance capable of measuring 1/100 of a gram. Early testing revealed discrepancies between calculated and measured results due to pump fuel and non-laboratory conditions. Subsequent testing using certification fuel, a temperature controlled enclosure, and a control container produced repeatable, accurate results.

Attachment 1

Portable Fuel Container Pre-Fueling Vent Emissions

June 29, 2004
All Measurements in Grams

A. Teired 65 to 105 Temperature Profile

PFC ID	Initial Weight	Pre 85	Post 85	Burp	Pre 95	Post 95	Burp	Pre 105	Post 105	Burp	Total
Md 1-1	1820.08	1819.70	1819.14	0.56	1818.88	1818.08	0.80	1817.68	1816.57	1.11	2.47
Md 1-2	1763.19	1762.77	1762.15	0.62	1761.95	1761.14	0.81	1760.88	1759.56	1.32	2.75
Md 2-1	3341.91	3340.86	3340.75	0.11	3340.25	3339.53	0.72	3339.19	3338.29	0.90	1.73
Md 2-2	3356.11	3355.05	3354.86	0.19	3354.54	3353.63	0.91	3353.26	3351.97	1.29	2.39
Md 2-3	3319.17	3318.54	3317.74	0.80	3317.55	3316.17	1.38	3315.90	3314.54	1.36	3.54
Md 5-1	8154.30	8152.00	8151.20	0.80	8149.40	8147.70	1.70	8145.80	8143.50	2.30	4.80
Md 5-2	8133.60	8131.50	8131.10	0.40	8129.10	8126.80	2.30	8125.70	8122.90	2.80	5.50
NS 1-1	2265.86	2265.30	2264.64	0.66	2264.37	2263.36	1.01	2263.06	2261.61	1.45	3.12
NS 1-3	1919.75	1919.00	1918.66	0.34	1918.33	1917.43	0.90	1917.06	1915.76	1.30	2.54
NS 2-1	4513.16	4512.24	4511.43	0.81	4510.88	4509.65	1.23	4509.17	4507.73	1.44	3.48
NS 2-2	4437.94	4437.08	4436.53	0.55	4436.23	4435.11	1.12	4434.91	4433.67	1.24	2.91
NS 2-3	4490.76	4489.81	4489.00	0.81	4488.63	4487.63	1.00	4487.30	4485.87	1.43	3.24
Sp 1-1	1866.79	1866.62	1865.00	1.62	1865.80	1865.04	0.76	1864.82	1863.65	1.17	3.55
Sp 1-2	1883.19	1882.98	1882.45	0.53	1882.32	1881.49	0.83	1881.26	1879.96	1.30	2.66
Sp 2-1	3400.76	3400.30	3399.37	0.93	3399.16	3398.14	1.02	3397.89	3396.26	1.63	3.58
Sp 2-2	3480.13	3479.74	3478.76	0.98	3478.53	3477.39	1.14	3477.06	3475.50	1.56	3.68
Sp 2-3	3434.66	3434.16	3433.31	0.85	3433.05	3431.90	1.15	3431.65	3429.84	1.81	3.81
Wd 1-1	2168.84	2168.40	2167.99	0.41	2167.73	2166.92	0.81	2166.63	2165.12	1.51	2.73
Wd 1-2	2081.79	2081.60	2080.69	0.91	2080.41	2079.08	1.33	2078.86	2077.50	1.36	3.60
Wd 1-3	3192.78	3192.65	3191.79	0.86	3191.53	3190.74	0.79	3190.50	3189.48	1.02	2.67
Wd 2-1	4404.08	4403.16	4402.62	0.54	4402.32	4401.36	0.96	4400.99	4399.22	1.77	3.27
Wd 2-2	4363.31	4362.71	4361.72	0.99	4361.53	4360.14	1.39	4359.78	4358.04	1.74	4.12
Wd 2-3	4348.06	4347.49	4346.44	1.05	4346.28	4345.05	1.23	4344.59	4342.29	2.30	4.58
Wd 5-1	8529.80	8529.10	8525.80	3.30	8524.90	8520.90	4.00	8520.50	8517.40	3.10	10.40
Wd 5-2	8493.60	8493.00	8489.70	3.30	8488.80	8485.30	3.50	8484.90	8482.20	2.70	9.50

1-gallon Average: 2.90

B. Single 65 to 105 Temperature Profile

2 - 2.5-gallon Average: 3.36

5-gallon Average: 7.55

PFC ID	Wt 65	Wt 105	Burp
MW 1-2	1756.49	1756.46	0.03
MW 2-1	3337.81	3336.19	1.62
MW 2-2	3352.01	3350.46	1.55
MW 2-3	3314.4	3312.46	1.94
MW 5-1	8142	8136.8	5.20
MW 5-2	8122.7	8116.5	6.20
NS 1-1	2257.91	2256.05	1.86
NS 1-3	1913.98	1911.45	2.53
NS 2-2	4432.32	4429.31	3.01
NS 2-3	4485.53	4482.65	2.88
Sp 1-1	1863.58	1862.08	1.50
Sp 1-2	1880.07	1878.66	1.41
Sp 2-1	3396.44	3394.44	2.00
Sp 2-2	3475.71	3473.61	2.10
Wd 1-1	2164.68	2163.31	1.37
Wd 1-2	2077.02	2075.64	1.38
Wd 1-3	3188.93	3187.77	1.16
Wd 2-1	4399.4	4397.12	2.28
Wd 2-2	4357.84	4355.4	2.44
Wd 2-3	4341.48	4338.14	3.34
Wd 5-1	8517.9	8513.8	4.10
Wd 5-2	8482.5	8477.6	4.90